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PRELIMINARY (30%) DESIGN SUBMITTAL / PRE-DESIGN INVESTIGATION WORK PLAN

Operable Unit 2 North Penn Area 5 Superfund Site
Unilateral Administrative Order (UAO)
Docket No. CERCLA-03-2012-0205DC

Submitted on Behalf of

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CERTIFICATION

Except as provided below, I certify that the information contained in or accompanying this Preliminary (30%) Design Submittal / Pre-Design Investigation (PDI) Work Plan (PDI Work Plan) is true, accurate, and complete.

As to those portions of this PDI Work Plan for which I cannot personally verify their accuracy, I certify under penalty of law that this PDI Work Plan and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: ______________________________________

Name: ______________________________________

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Title: ______________________________________

Date: ______________________________________

TABLE OF CONTENTS

**TABLE OF CONTENTS
(continued)**

TABLE OF CONTENTS
(continued)

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS

cDCE	cis-1,2-dichloroethene; cis-1,2-dichloroethylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCs	chemicals of concern
CSIA	compound specific isotopes analysis
CSM	conceptual site model
Dhb	Dehalobacter
Dhc	dehalococcoides
DHG	dissolved hydrocarbon gases
DO	dissolved oxygen
EISB	enhanced in situ bioaugmentation
EVO	emulsified vegetable oil
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	geographic information system
GPS	Global Positioning System
HASP	Health and Safety Plan
MCL	maximum contaminant level
µg/L	microgram per liter
MIP	membrane interface probe
MS/MSD	matrix spike/matrix spike duplicate
NELAP	National Accredited Laboratory Accreditation Program
NP5	North Penn Area 5
NPL	National Priorities List
NPWA	North Penn Water Authority
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OU	operable unit
OU1	Operable Unit 1

LIST OF ACRONYMS
(continued)

OU2	Operable Unit 2
OU3	Operable Unit 3
PADEP	Pennsylvania Department of Environmental Protection
PPC	Preparedness, Prevention and Contingency
PCE	tetrachloroethene; tetrachloroethylene; perchloroethene
PDI	pre-design investigation
PID	photo-ionization detector
PPE	protective personal equipment
PRP	Potential Responsible Party
QA	quality assurance
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance and quality control
QC	quality control
RA	Remedial Action
RAO	Remedial Action Objectives
RD	Remedial Design
RD/RA	Remedial Design and Remedial Action
RDWP	Remedial Design Work Plan
redox	oxidation-reduction
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RPM	Remediation Project Manager
SMP	Site Management Plan
SOP	standard operating procedure
SPCC	Spill Prevention, Control and Countermeasure
TCE	trichloroethene, trichloroethylene
TEA	terminal electron acceptor

LIST OF ACRONYMS
(continued)

UAO	Unilateral Administrative Order
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VC	vinyl chloride
vcrA	vinyl chloride reductase
VOCs	volatile organic compounds
WMP	Waste Management Plan

1. INTRODUCTION

This Preliminary (30%) Design Submittal / Pre-Design Investigation (PDI) Work Plan (PDI Work Plan) was prepared by Geosyntec Consultants, Inc. (Geosyntec) on behalf of Stabilus, Inc. (Stabilus), a named Respondent to the Unilateral Administrative Order (UAO) Docket No. CERCLA-03-2012-0205DC dated 26 June 2012 (USEPA, 2012), for the interim remedy selected by the United States Environmental Protection Agency (USEPA) for Operable Unit 2 (OU2) of the North Penn Area 5 Superfund Site in Hatfield and New Britain Townships (aka, Colmar), Montgomery and Bucks Counties, Pennsylvania (the “Site” or “NP5 Site”, Figures 1 and 2).

This PDI Work Plan is being submitted to the USEPA pursuant to Section VI Paragraph 25.b of the UAO and as detailed within the 29 January 2013 Remedial Design Work Plan (RDWP; Geosyntec, 2013). The UAO was issued for the completion of the Remedial Design (RD) and Remedial Action (RA) to implement the 7 September 2011 Record of Decision (Interim ROD) for the enhanced *in situ* bioaugmentation (EISB; USEPA, 2011) interim remedy. The USEPA selected the EISB remedy to address elevated levels of volatile organic compounds (VOCs), which have been historically detected in the OU2 overburden groundwater.

As outlined in the RDWP, this Preliminary (30%) Design Submittal (aka, PDI Work Plan) is the first of the four submittals of the detailed design sequence and focuses on the collection of PDI data needs. The PDI Work Plan incorporates the elements of the Design Sampling and Analysis Plan including the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP); Site Management Plan (SMP); Health and Safety Plan (HASP); Waste Management Plan (WMP); and Spill Prevention Contingency Countermeasures (SPCC) Plan. The PDI Work Plan also provides the groundwater interim remedy treatment area delineation approach and EISB treatability study plan.

1.1 Pre-Design Investigation Objectives

The USEPA established Remedial Action Objectives (RAOs) in the OU2 Interim Record of Decision (ROD). The RAOs for the interim OU2 EISB remedy are as follows:

- Reduce a source of contamination by restoring groundwater quality in the treatment area of the overburden to maximum contaminant levels (MCLs) established under the Safe Drinking Water Act;
- Prevent or minimize further migration of contaminants from the overburden; and
- Prevent future exposure to contaminated groundwater at concentrations above MCLs.

The primary objectives of the RD are to gather supplemental information at OU2, perform engineering evaluations to support the preparation of construction drawings and specifications to achieve the RAOs through EISB, and to meet the other performance standards and requirements set forth in the Interim ROD and UAO, and summarized within the RDWP (see RDWP

Section 1.4). The RD will be developed with these RAOs and remedy performance standards as the goal of the implemented RA.

An objective of the PDI is to provide updated data relative to the current nature and extent of VOCs in the OU2 overburden groundwater. These data will be used to define the EISB treatment zone, to identify locations of the EISB injection and to aid in the design of the performance monitoring well network.

Environmental Resources Management, Inc. (ERM) completed a bioaugmentation bench-scale treatability study which concluded that EISB was a viable in situ remedial approach for OU2 (ERM, 2004). The ROD requires that a "*second bench-scale study be conducted as part of the design of the interim remedy to determine the best mix of nutrients and microbial cultures required to optimize biodegradation processes and achieve performance standards in-situ*". Data to be collected during the PDI to support the EISB design include the composition of the VOC contaminant suite and groundwater redox and biogeochemical conditions in the OU2 groundwater. These data are necessary to select the appropriate biostimulant, bioaugmentation culture, and (potentially) pH buffering amendments.

1.2 Report Organization

This PDI Work Plan is organized as follows:

- **Section 2**: Background Information. An overview of the OU2 layout, geology, hydrogeology, geology, regulatory history, and historic Site conditions;
- **Section 3**: Pre-Design Data Gaps. A summary of the information needed to aid in the RD for the EISB remedy and to aid in development of the overburden groundwater conceptual site model (CSM);
- **Section 4**: Site Management Plan. Describes the management of the RD to complete the work at the Site and includes the HASP, SPCC Plan, and WMP;
- **Section 5**: Field Sampling Plan. Provides the details of the FSP specific to the overburden groundwater delineation field activities including the sampling locations and procedures;
- **Section 6**: EISB Treatability Study Plan. Provides the details for the EISB treatability study including number and quantity of microcosms, testing to be completed and anticipated duration;
- **Section 7**: Quality Assurance and Quality Control. Summarizes the procedures and methods to be implemented for the PDI activities for the Quality Assurance Project Plan (QAPP); and
- **Section 8**: References.

2. BACKGROUND INFORMATION

Detailed information on the Site history is presented in Section III of the UAO, Section II of the ROD for OU1 and OU3, and Section II of the Interim ROD for OU2 (USEPA, 2011, 2004, and 2012). Background information relative to the OU2 interim remedy is discussed below.

2.1 Site Description

The Site layout and setting, geology and hydrogeology are summarized below.

2.1.1 Layout and Setting

The NP5 Site is located within Hatfield and New Britain Townships, in Montgomery and Bucks Counties, Pennsylvania (Figure 1). NP5 encompasses an area of approximately five square-miles that is generally bounded by Richardson Road to the southeast, Bethlehem Pike (Route 309) to the west, Trewigtown Road to the northwest and Schoolhouse Road to the east (Figure 2). As noted, the focus of this PDI Work Plan is the area located on the former Stabilus property and the former BAE Systems, Inc. and BAE Systems Information and Electronic Systems Integration, Inc. (BAE) property shown as the OU2 area on Figure 3.

Although the NP5 Site is within an area comprised of commercial and industrial businesses, residences, undeveloped woodland properties, parkland and farmland, the area where the interim remedy is to be performed at OU2 is in the vicinity of the former Stabilus and former BAE industrial properties. The topography within OU2 slopes gently from the northwest and southeast toward the West Branch of the Neshaminy Creek. Large portions of OU2 are relatively flat-lying from grading associated with construction or agriculture. The major surface water bodies in the vicinity of OU2 include the West Branch of the Neshaminy Creek, its Western and Eastern tributaries, and an unnamed tributary to the Neshaminy Creek as shown on Figures 1 and 2.

2.1.2 Geology

The NP5 Site is located within the Triassic Lowlands section of the Piedmont Physiographic Province and is underlain by sedimentary rocks of the Brunswick and Lockatong Formations of the Newark Supergroup. Bedding in the Newark Supergoup generally strikes northeast and dips to the northwest. These formations have been well studied by the United States Geological Survey (USGS) and others through investigations of regional groundwater contamination over the last three decades. The Brunswick and Lockatong Formations are part of a homoclinal structure that strikes northeast to southwest and dips from approximately 20° to 30° to northwest (Bird and Conger, 2002; Riser and Bird, 2003; Bird, 2006). The lower beds of the Brunswick Formation consist of red to reddish brown and gray to greenish-gray mudstones, clay, and mud-shales. The bedding is irregular and wavy. The Lockatong Formation rocks are thinly-bedded and evenly-bedded shales and siltstone that are medium to dark gray and olive to greenish-gray.

Bedrock beneath the Site is mantled with an overburden (regolith) comprised of silt, clay, and some sand. The regolith was formed through the gradational weathering of the underlying sedimentary bedrock. The overburden is typically 10 to 40 feet thick and generally more competent and less permeable with depth. The upper portion of the overburden is typically unsaturated; however saturated conditions do occur within the overburden. Generally, the base of the overburden and the thicker sections of overburden are perennially saturated during normal precipitation conditions. The overburden groundwater within OU2 is the subject unit of the PDI and associated EISB remedy.

Site-specific investigations confirm that the bedrock surface beneath the OU2 overburden forms a trough or shallow basin. This feature is significant with respect to the overburden thickness and the resulting distribution of VOCs in saturated soils. Figure 4 presents a visualization of the bedrock topography prepared as part of USEPA's investigation data from 1998 and 2003 using the depth to the top of bedrock measured during subsurface soil boring investigations within the overburden. The alignment of the bedrock trough trends along bedrock strike (shown within the blue dashed lines on Figure 5). Highs in bedrock surface elevation straddle the bedrock trough (shown as red dashed outlines on Figure 5). A high in bedrock surface elevation may also be present along the line of the bedrock trough southwest of the former Pond Area (also shown as red dashed outline on Figure 5).

2.1.3 Hydrogeology

Groundwater originates from infiltration of local precipitation through the overburden into the bedrock fracture network, and eventually discharges to surface water features (i.e., streams, rivers). The overburden is largely unsaturated, but does contain groundwater at its base above the bedrock, especially during periods of higher seasonal recharge. The thicker sections of overburden, such as those in the vicinity of the former BAE and former Stabilus properties, have historically contained a saturated zone of approximately 3 to 10 feet in thickness year-round. The depth to groundwater in this overburden unit has historically ranged from 4 to 10 feet below grade.

The groundwater flow direction in the OU2 overburden unit is locally variable, but overall is vertical down to the top of the bedrock. Factors influencing the overburden groundwater flow direction include the permeability of the regolith and the presence of relict rock fabric (former bedrock bedding planes and joints) in the weathered bedrock portions of the overburden. OU2 overburden groundwater may flow horizontally along the interface between the bedrock and the overburden and would thus follow the topography of the bedrock surface until it drains under gravity. Once in the bedrock fracture system, groundwater flows through the vertical joints and horizontal fractures in the shale and siltstone bedrock. Groundwater may occur under confined or unconfined conditions within bedrock depending upon the thickness of the overlying overburden.

The bedrock has low primary porosity, but moderate to high secondary porosity via a network of fractures, bedding-planes, and high-angle joints throughout which groundwater exists and can flow vertically and horizontally. Most of the water-bearing fractures are located within the upper 80 to 100 feet of the surface. The frequency of bedrock fractures generally decreases with depth. The shallow portion of the bedrock aquifer consists of a fracture zone that exists at depths of approximately 90 to 100 feet below the surface. The depth to groundwater in this aquifer has historically varied from 10 to 30 feet below grade. Groundwater flow in this aquifer has been influenced by the local bedrock structure and in response to gradients induced by historic regional pumping. Historically, groundwater in this portion of the aquifer generally flows in a direction similar to topographic gradient generally towards the West Branch Neshaminy Creek and its tributaries. Groundwater flow north of the West Branch Neshaminy Creek is generally southeasterly, and groundwater flow south of the creek is generally northeasterly. Groundwater in this portion of the aquifer eventually discharges to the surface streams or provides recharge to the deeper aquifer system.

The deeper portion of the bedrock aquifer consists of the fracture zone greater than 100 feet below the surface to an approximate maximum depth of 500 feet. The geology and groundwater flow conditions of the deeper portion of the bedrock aquifer are similar to that of the shallower, albeit with fewer water-bearing fractures.

2.2 Overview of OU2 Regulatory History

NP5 was first identified in 1979 with the detection of VOCs in groundwater from North Penn Water Authority (NPWA) supply well NP-21. In 1986, USEPA completed an assessment of contamination in the NP5 area. Based on the results of the 1986 assessment, USEPA proposed the Site to be listed on the National Priorities List (NPL) on 22 January 1987. On 31 March 1989, USEPA finalized the listing of the Site on the NPL. For NP5, three primary areas of groundwater contamination were identified and defined as separate and distinct operable units (OUs). Per the UAO, the general location of OU1, OU2 and OU3 are described as follows:

- **OU1:** located at and in the vicinity of the property located at 305 Richardson Road in Colmar, Pennsylvania, formerly owned and operated by BAE, and currently owned and operated by Sensor and Antenna Systems Lansdale, Inc. (Sensor) with portions that may extend to other properties. EPA identified BAE as the sole responsible party at OU1;
- **OU2:** located at and in the vicinity of three industrial properties, including the industrial property located at 92 County Line Road in Colmar, Pennsylvania, currently operated by Constantia Colmar, Inc. (Constantia) and formerly operated by Stabilus, the industrial property located at 305 Richardson Road, formerly owned and operated by BAE, and the industrial property located at 4379 County Line Road owned and operated by Kema-Powertest, with portions that may extend to other properties. EPA issued general or special notice letters for OU2 to Stabilus, BAE,

Honeywell, Inc., Kema-Powertest, ZF Sachs Automotive of America, Inc., Constantia, County Line Land Limited, and County Line Land Corporation; and

- **OU3:** located in the vicinity of Advance Lane and Enterprise Lane in Colmar, Pennsylvania. EPA identified no potential responsible parties (PRPs) for OU3.

USEPA initiated a fund-lead Remedial Investigation and Feasibility Study (RI/FS) in 1998, under which the USEPA studied a five square-mile area that included properties associated with eight commercial businesses. The RI revealed that trichloroethene (TCE) and related VOCs are present in the groundwater at each OU (USEPA, 2002a, 2002b, 2002c, and 2003).

In 2002, USEPA issued a proposed remedial action plan (PRAP) setting forth its preferred remedy for each OU at the Site (USEPA, 2002d). After reviewing the extensive comments submitted during the public comment period, USEPA decided to reassess the preferred remedy for OU2. In June 2004, the USEPA issued a ROD for OU1 and OU3 (USEPA, 2004) to conduct in situ chemical oxidation (ISCO) and pump and treat.

USEPA issued a revised PRAP for interim remedial action at OU2 on 15 September 2008 (Interim PRAP; USEPA, 2008a). The Interim PRAP presented EISB as the interim remedial action for the overburden within OU2 at the former Stabilus property and the former BAE property (Figure 3). The decision by USEPA on the selection of EISB is embodied in the Interim ROD (USEPA, 2011).

The execution of the RD/RA has been required with the issuance of the UAO on 26 June 2012. The RDWP was approved by USEPA on 16 January 2013 (USEPA, 2013; Geosyntec, 2013).

2.3 Site History

The Site history is well documented within the RI/FS (USEPA, 2002a and 2002b); Supplemental I RI/FS (USEPA, 2002c), Supplemental II RI/FS (USEPA, 2003), PRAP, (USEPA, 2002d), ROD (USEPA, 2004), Interim PRAP (USEPA, 2008a), Interim ROD (USEPA, 2011), and UAO (USEPA, 2012). Specific to the OU2 overburden the two affected properties are the former Stabilus property and the former BAE property. A summary of the ownership history and operations for these two properties follows (USEPA, 2011 and 2012):

- **Former Stabilus Property:** The former Stabilus property encompasses an area of approximately 11 acres. From 1979 to 1998, Stabilus (formerly Stabilus/Gas Springs Company) manufactured gas pistons or shock absorber type “springs” utilized in automobile hatch-backs, gates and trunks. From 1953 to 1979, approximately 4 acres of the southern portion of the property, which is an area included in the interim remedy for OU2, was owned by Tracor Aerospace Systems, Inc./American Electronic Laboratory, the predecessor to BAE. Constantia Colmar Group, formerly part of H&N Packaging, Inc., has operated on the property since 1999; and

- **Former BAE Property:** The former BAE property is a 67-acre property consisting of an electronics manufacturing and testing facility that began operations in 1953. From 1953 to 2008, the property was owned and operated by BAE Systems Information and Electronics Systems, Inc., and is formerly known as Marconi Aerospace Electronic Systems, Inc., Tracor Aerospace Systems, Inc., and American Electronics Laboratory. Historically, the operations included degreasing, anodizing, and nickel, copper, tin, and lead plating. Several buildings on the Site contained operations, which included a plating shop and a plating effluent waste treatment facility and product testing. Since February 2008, Sensor has owned the property.

2.4 Historic Site Conditions

Specific to the OU2 overburden, VOCs were detected in overburden groundwater beneath the former Stabilus property and the former BAE property as presented in the Supplemental II RI/FS (USEPA, 2003) and shown on Figure 3. The 2003 USEPA investigation identified two areas of observed elevated levels of TCE; one near the loading dock of the former Stabilus property; and the other located within the former BAE property near W-4 and RI-31. A suspected source of TCE identified near the former Stabilus property loading dock has been attributed to a spill caused by Baron Blakeslee, Inc., later Honeywell, which is identified in Section III Paragraph 9.e of the Findings of Fact in the UAO.

Based on a review of the public records for NP5 and as noted in the USEPA-prepared documents, (including the Responsiveness Summary issued by USEPA with the Interim ROD in September 2011 [USEPA, 2011]) USEPA has not identified a specific source for the elevated level of TCE in the overburden on the former BAE property. An objective of the PDI described herein is to resolve the nature and extent of groundwater contamination at OU2, including possible sources heretofore unidentified within the OU2 overburden groundwater. As noted in public comments to the ROD, PRAP, Interim ROD and USEPA Responsiveness Summary, these unidentified sources may include but not limited to areas described as the Sewer Area and Pond Area identified within the RI/FS documents (USEPA, 2002a, 2002b, 2002c, 2000d, 2003, 2008a, and 2011). The Sewer Area and Pond Area, as well as the Loading Dock Area, are within the bedrock trough discussed previously in Section 2.1.1, and are shown in relation to these overburden features on Figure 6.

3. PRE-DESIGN DATA OBJECTIVES

A well-resolved overburden CSM that incorporates the historic soil investigation results and present-day groundwater quality data is required for the RD. Several soil and groundwater investigations and sampling events have been conducted through the RI/FS process (USEPA, 2002a, 2002b, 2002c, and 2003). The data collected over the Site investigation history and the groundwater quality data to be collected during the PDI will be synthesized into a comprehensive overburden CSM as part of the PDI to represent the nature, extent, fate and transport of VOCs to support the OU2 EISB remedy design.

3.1 Overburden Groundwater VOC Nature and Extent

The delineation of VOCs, specifically TCE and related parent and daughter products (i.e. tetrachloroethene [PCE], cis-1,2-dichloroethene [cDCE], vinyl chloride [VC] and ethene.), in the overburden groundwater is a stated objective of the RI/FS (USEPA, 2002a and 2002b) and related Supplemental I and II RI/FS (USEPA, 2002c and 2003). Geosyntec reviewed data and findings from the following investigations to develop the PDI scope to fulfill the overburden groundwater delineation objective:

- 1998 USEPA overburden groundwater and soil investigation (USEPA, 2002a);
- 2001 USEPA membrane interface probe (MIP) overburden investigation (USEPA, 2002b);
- 2003 USEPA overburden groundwater investigation (USEPA, 2003); and
- 2005 BAE overburden groundwater and soil investigation (SEI, 2005).

Appendix A presents a series of TCE isoconcentration maps that represent the findings of the aforementioned groundwater investigations and identify two distinct overburden areas of elevated TCE groundwater concentration in general alignment with bedrock strike. Given the variability in the groundwater concentrations, other separate zones of contamination may also exist. The distribution of TCE in overburden groundwater within OU2 appears to follow the topography of the bedrock surface. Figure 6 presents the inferred bedrock trough boundary and TCE isoconcentration contours interpreted by the USEPA from Direct Push sampling conducted in May 2003 and presented in the Supplemental II RI/FS (USEPA, 2003). Together, these data suggest that the OU2 overburden groundwater TCE plume is largely contained within the bedrock trough.

Nearly a decade has passed since the last overburden groundwater sampling event was performed. OU2 groundwater VOC concentrations were compared over the period from 1998 to 2003 and the limited data indicated that groundwater TCE concentrations were decreasing (ERM, 2003). The PDI sampling approach has been developed to assess the present-day VOC conditions and to better understand the nature of TCE source(s) associated with the OU2 overburden groundwater plume as described in Section 3.2.

3.2 PDI Sampling Design and Rationale

The PDI sampling design and rationale was developed to update and further delineate the OU2 overburden groundwater VOC plume and to collect design data for the EISB remedy. The current overburden groundwater conditions will be assessed at a total of 40 locations as shown on Figure 7. All locations will be completed with a pneumatic hammering direct push rig. At 12 of the sampling locations (TW01 to TW12) temporary monitoring wells will be constructed at locations shown on Figure 7. Grab groundwater samples will be collected using a temporary 1-inch sampling point (temporary sampling point of 1-inch Schedule 40 PVC 5-foot 10-slot screen and riser within open borehole) from the remaining 28 locations (TW13 to TW40) (Figure 7). This PDI OU2 overburden groundwater sampling approach will provide data to evaluate the current spatial distribution of overburden groundwater VOCs and potential VOC source(s). In addition to the OU2 overburden groundwater sampling, soil samples will be collected at ten temporary monitoring well locations to evaluate the potential for VOC sorption into the soil and/or weathered bedrock matrix shown as SB01 to SB10 on Figure 7. The selection of the soil sampling intervals with SB01 to SB10 will be made in the field based on the highest screened interval of photoionization detector (PID) responses taken every 6-inches of recovered soil from soil cores during the temporary monitoring well installations. Select soil samples will also be used for the construction of microcosms in the EISB treatability study, which will also be targeted towards the highest PID response.

3.3 EISB Design and Baseline Groundwater Assessment

ERM completed a bioaugmentation treatability study, which concluded that EISB was a viable in situ remedial approach for OU2 (ERM, 2004). The conclusions of the 2004 bioaugmentation treatability study indicated: 1) the growth of indigenous microorganisms can be sustained and stimulated through the addition of an electron donor; 2) bioaugmentation is necessary to achieve complete reductive dechlorination of TCE to ethene; and 3) emulsified vegetable oil (EVO) is the best substrate given its longevity within the subsurface. Additional data collection and testing will be performed as part of the PDI to support the EISB design.

The OU2 EISB remedy will involve the subsurface delivery of a carbon source (e.g., EVO) capable of supplying electrons during oxidation-reduction (redox) reactions. Chemically reducing anaerobic conditions are required for the complete reductive dechlorination of the Site VOCs. The oxidation-reduction potential (ORP) is a measure of the tendency of the ground water to be chemically reducing (donate electrons) or oxidizing (accept electrons). Microorganisms obtain energy by transferring electrons from an electron donor to a terminal electron acceptor (TEA) such as iron, nitrate and sulfate. The TEA processes from aerobic to increasingly anaerobic are as follows:

- Oxic – significant oxygen is present (aerobic conditions).

- Nitrate reduction - nitrate is reduced under anaerobic conditions to gaseous forms or may terminate at nitrite.
- Iron reduction – ferric iron (Fe^{3+}) is reduced under anaerobic conditions to ferrous iron (Fe^{2+}).
- Manganese reduction – Manganese as Mn^{4+} is reduced under anaerobic conditions to Mn^{2+}.
- Sulfate reduction - sulfate (SO_4) is reduced under anaerobic conditions and is reduced to sulfide.
- Methanogenesis - bacteria oxidize hydrogen to create methane under strongly anaerobic conditions. Methanogenic conditions are typically required for complete biodegradation of TCE to ethene.

The EISB design requires a comprehensive groundwater biogeochemical assessment to understand redox zonation through the spatial distribution of the TEA process occurring in the aquifer. This information will support the selection and dosing of the appropriate biostimulants and bioaugmentation cultures for the full-scale EISB remedy. Purging of the temporary wells will enable the collection of field parameters to assess groundwater redox (e.g. dissolved oxygen [DO] and ORP) from temporary monitoring wells TW01 through TW10 (Figure 7). Groundwater from the temporary monitoring wells will be sampled and analyzed for anions (e.g. nitrate, nitrite, chloride, and sulfate) indicative of TEA processes occurring in the overburden groundwater.

The field parameter redox and TEA data will also be part of a baseline data set representative of the OU2 overburden groundwater conditions prior to EISB treatment. Concentrations of nitrate, iron and sulfate (if present) should decrease after biostimulation until the methanogenic conditions requisite for sustaining the dehalogenating microorganisms are achieved and sustained.

Compound Specific Isotope Analysis (CSIA) will be performed on groundwater samples collected from temporary monitoring wells TW01 through TW10 (Figure 7). CSIA generates isotopic characterization of individual compounds (e.g. TCE), which can be used to quantitatively assess degradation processes (USEPA, 2008b). The collection of CSIA data before, during and after EISB treatment will provide unambiguous evidence of enhanced biodegradation, as well as the mechanisms, rate and extent of degradation of TCE in the EISB treatment area.

4. SITE MANAGEMENT PLAN (SMP)

The Site Management Plan (SMP) describes the means by which Stabilus plans to perform the RD in satisfaction of the UAO. Incorporated in this SMP are the plans for project management, project schedule, access, security, contingency procedures, management responsibilities, community relations, waste disposal, and data handling.

4.1 Project Management

The overall RD Project Management was detailed within the RDWP (see Figure 4 in RDWP). Further details specific to the completion of the PDI field activities are presented within the FSP in Section 5, and completion of the EISB treatability study within Section 6. The PDI project team organization is shown on Figure 8.

4.2 Remedial Design Implementation Timeline

As detailed within the RDWP, the scope of work for the RD includes completion of the ESIB design to meet the requirements within the UAO and Interim ROD. The RD requires PDI activities that include overburden groundwater delineation and completion of the EISB treatability study. Additionally, installation of performance monitoring wells within the overburden and shallow bedrock as part of the RA activities will be installed consistent with the RDWP timeline. The RD will include preparation of design drawings for a Preliminary RD, Pre-Final RD and Final RD. The implementation timeline for these tasks and the related submittals has changed slightly from that presented within the RDWP, a revised RD Implementation Timeline is provided as Figure 9.

4.3 Site Access and Control

The Site is not owned or controlled by Stabilus. In accordance with Section VIII, Paragraph 39 of the UAO, Stabilus has pursued access agreements with the current property owners. Constania has agreed to provide access to the former Stabilus facility. Sensor has agreed to provide access to the former BAE facility property. Access to the Whistle Stop Park has been informally obtained from Montgomeryville Township and awaiting formal approval as of this writing. The access will be for the work deemed necessary to meet the obligations of the UAO for both the RD and RA to implement the interim remedy of EISB within the overburden of OU2.

Stabilus will remain responsible for maintaining Site security, precluding public access for the protection of the public during completion of RD and RA field activities. Temporary fencing will be used to secure the staging area and waste handling area. Additional site security is not deemed necessary.

4.4 Pre-Design / Design Safety Plans

Safety plans for completion of the PDI activities include the HASP and SPCC Plan.

4.4.1 Health and Safety Plan (HASP)

A HASP was prepared to establish the procedures, personnel responsibilities and training necessary to protect the health and safety of field personnel during the completion of field activities for the RD. The HASP was prepared per Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 requirements providing procedures and plans for routine field activities and for unexpected Site emergencies. The HASP includes delineation of exclusion zones, describes the field personnel responsible for implementing the HASP, protective personal equipment (PPE), decontamination procedures, workspace air monitoring, and medical surveillance and other requirements defined in 29 CFR 1910.120. A copy of the HASP for RD field activities is included within Appendix B.

4.4.2 Spill Prevention, Control, and Countermeasure (SPCC) Plan

The SPCC Plan focuses on spill prevention, preparedness, and response in the event of a discharge during the completion of the RD field activities. The SPCC Plan is designed to protect public health, public welfare, and the environment from potential harmful effects of a discharge of Site contaminants to the surrounding soil and/or groundwater. Per USEPA Clean Water Act regulation (40 CFR 112) the requirement of a SPCC is for oil releases; however, PADEP Clean Stream Law for Preparedness, Prevention and Contingency (PPC) regulation (25 PA Code 91.34) refers to pollutants. The areas addressed by the SPCC are as follows:

1) Operating Procedures to Prevent a Pollutant Spill:
   - The drilling method will be direct push. No drilling fluids will be used in completion of the investigation locations.
   - Soil sampling will generate soil spoils for the intervals not sampled. These soils will be disposed of as investigation derived waste (IDW) and handled as noted in the Waste Management Plan (see Section 4.7). Once the soils have been characterized, and appropriate samples collected, the soils will be deposited directly to a 55-gallon steel drum. Once full, the 55-gallon steel drum will be secured closed and transferred to the Waste Management Area within the drum containment area.
   - Groundwater sampling of the direct push grab sampling locations, temporary well sampling locations, and existing well sampling locations will generate small quantities of groundwater. The transfer of groundwater from the sampling pump to the sample containers will be conducted within secondary containment (e.g. over a 5-gallon bucket) to capture spills/overview. The collected groundwater will be contained temporarily within 5-gallon buckets and then transferred to 55-gallon steel drums within the drum containment pad of the Waste Management Area. The

transfer to the drums will be via a drum funnel or like liquid transfer method. If spills were to occur, these spills will be small in volume (<5 gallons) and will occur within the secondary containment of the Waste Management Area. No further containment during transfer is anticipated necessary.

- Spills during development of the temporary wells and purging for groundwater sampling will be mitigated through continuous oversight, use of competent tubing and securing of the tubing to the collection vessels. Purging and development will be performed with constant monitoring of the pumping activities, thus allowing the immediate shut off of pumping equipment in the event of a spill. Competent tubing will be used and secured to either a 55-gallon drum for development of the temporary wells, or secured to a 5-gallon bucket for purging of wells prior to groundwater sampling.

2) Control Measures Installed to Prevent Pollutant from Entering Navigable Waters:

- As noted, PDI field activities will generate both soil and liquid IDW, which will be handled as noted in the Waste Management Plan (see Section 4.7). To aid in containment of these IDW, the drum staging area within the waste management area will be constructed with secondary containment. Additionally, the Waste Management Area will be secured with a lockable fence. As noted in Section 4.7, the IDW is anticipated to be non-hazardous. These security measures will be implemented to limit the potential for vandalism and potential release.

- In the event of a release, the solids and/or liquid IDW will be contained within secondary containment. Spilled liquid IDW will be pumped or otherwise transferred into a 55-gallon drum specified for liquid IDW disposal. Impacted soils will be collected and placed into a 55-gallon drum specified for solid IDW disposal. Spilled soil IDW will be transferred into a 55-gallon drum specified for solid IDW disposal.

3) Countermeasures to Contain, Cleanup, and Mitigate the Effects of a Pollutant Spill that has an Impact on Navigable Waters:

- IDW will be contained within secondary containment; thus, no release to navigable waters is anticipated.

- No further countermeasures are anticipated necessary given the material to be managed.

In the event of a discharge of site contaminants to navigable waters or adjoining shorelines, the following information will be provided to the National Response Center (1-800-424-8802) immediately following identification of a discharge to navigable waters or adjoining shorelines:

- Address or location and phone number of the facility;
- Date and time of the discharge;
- Type of material discharged;

- Estimate of the total quantity discharged;
- Estimate of the quantity discharged to navigable waters;
- Source of the discharge;
- Description of all affected media;
- Cause of the discharge;
- Any damages or injuries caused by the discharge;
- Actions being used to stop, remove, and mitigate the effects of the discharge;
- Whether an evacuation may be needed; and
- Names of individuals and/or organizations who have also been contacted.

4.5 Community Relations

Community relations are not anticipated to be necessary as part of the RD activities, and the USEPA RPM indicated during a meeting on 11 October 2012 that if deemed necessary USEPA will manage community relations as part of the RD. Stabilus will continue to support USEPA in their efforts as needed for community relations.

4.6 Permits

Permits are not anticipated to be necessary during the completion of the RD field activities.

4.7 Waste Management Plan (WMP)

During completion of the RD field activities, both solid and liquid IDW will be produced. Waste management procedures for IDW are based on the *Management of Investigation-Derived Wastes During Site Inspections* (USEPA, 1991) and *Guide to Management of Investigation-Derived Wastes* (USEPA, 1992a), and good engineering judgment. Waste generated during RD field activities will consist of soil, groundwater, drilling mud and personal protective equipment (PPE).

4.7.1 Solid IDW

Field activities will generate IDW solids including soil cuttings and excess soil sample material. IDW of this type will be containerized in properly labeled containers for later disposal. This soil-related IDW is anticipated to be non-hazardous in nature, but will be sampled and analyzed to confirm that it is non-hazardous prior to disposal. One composite sample will be collected per ASTM D6051 (ASTM, 2006) from the drums containing soil/solid IDW and analyzed for the parameters summarized on Table 1 for waste profiling. Containerized IDW will be staged within the defined laydown and equipment staging area shown on Figure7 within a secondary containment drum staging area.

IDW consisting of used PPE, disposable equipment (bailers, rope, acetate liners, etc.), and other trash that may have come in contact with contamination, will be rendered non-hazardous through the removal of gross contamination. Gross contamination removed from the PPE IDW will be placed with the appropriate IDW. IDW rendered non-hazardous through the removal of gross contamination will be bagged and disposed as municipal solid waste.

4.7.2 Liquid IDW

Field activities will generate liquid IDW including purge fluid and excess sample material. Liquid IDW of this type will be containerized in properly labeled containers for later disposal. This groundwater-related liquid IDW is anticipated to be non-hazardous in nature, but will be confirmed prior to disposal. One composite sample will be collected per ASTM D6051 (ASTM, 2006) from the drums containing liquid IDW and analyzed for the parameters summarized on Table 1 for waste profiling. Containerized liquid IDW will be staged within the defined laydown and equipment staging area shown on Figure 7 within a secondary containment drum staging area.

4.8 Data Management

Data will be managed using the EnviroData data management system in conjunction with the ArcView geographic information system (GIS) tools to manage, summarize, and present the data.

5. FIELD SAMPLING PLAN (FSP)

This section presents the organizational structure for sampling and analysis activities associated with the PDI, including team organization and responsibilities, fieldwork schedule, sampling methods, data management, and laboratory analyses. The focus of the PDI field sampling effort is to complete the overburden groundwater delineation and to collect soil and groundwater for the EISB treatability study. The FSP is presented below. The EISB treatability study plan is presented in Section 6. Copies of Geosyntec standard operation procedures (SOPs) referenced below are provided in Appendix C.

5.1 Team Organization and Responsibilities

The organizational structure for the PDI team is presented in Figure 8 and summarized as follows:

- **USEPA:** The USEPA is the lead governmental agency for the Site. The USEPA will oversee all aspects of the interim remedy RD/RA. Ms. Sharon Fang is the Remedial Project Manager (RPM) for USEPA, responsible for overall oversight of the NP5 Site and OU2 interim remedy and monitoring compliance of the interim remedy with the Interim ROD and UAO;
- **USEPA RD Oversight Contractor:** The USEPA RD Oversight Contractor assists the USEPA RPM on oversight of the RD, RD Site activities, and other technical aspects of the completion of the RD for the interim remedy. Hydrogeologic, Inc. in Philadelphia, Pennsylvania will serve as the USEPA RD Oversight Contractor;
- **Pennsylvania Department of Environmental Protection:** PADEP is the support agency to USEPA for the Site. PADEP will review and provide their input or concurrence, as needed during completion of the RD/RA components of the interim remedy. Mr. Timothy Cherry of PADEP is the current point of contact;
- **Supervising Contractor and Project Coordinator:** Geosyntec is the Supervising Contractor and Mr. Derek W. Tomlinson, P.E., of Geosyntec is the Project Coordinator. The Project Coordinator will act as a liaison between the USEPA, Stabilus, RD contractors and subcontractors, and RA contractors and subcontractors. The Project Coordinator will verify that the PDI, RD, and RA activities are performed in substantial accordance with the UAO and Interim ROD and other related technical design requirements;
- **Remedial Design Contractor:** Geosyntec is the RD Contractor. The RD Contractor will fulfill the requirements of the UAO specific to the RD of the USEPA selected remedy. The RD Contractor personnel consists of the following:
  - RD Engineer is Mr. Derek W. Tomlinson, P.E.;
  - RD Geologist is Mr. Christopher Voci, P.G.;
  - Quality Assurance Officer is Ms. Julia K. Caprio, M.Sc., MBA;

  - Project Environmental, Health and Safety Officer is Mr. Scott Douglas with support from Corporate EHS Officer Mr. Dale Prokopchak, CIH, CSP;
  - Field Manager and Site Health and Safety Officer is Ms. Michelle Mirigliano; and
  - Field Scientists are yet to be determined.
- **EISB Treatability Study Subcontractor:** SiREM Laboratories, Inc. (SiREM) of Guelph, Ontario, Canada will perform the EISB treatability study and related analytical services. The SiREM point of contact will be Ms. Sandra Dworatzek;
- **Laboratory Subcontractors:** Laboratory analytical services will be provided by the following:
  - Lancaster Laboratories, Inc. (Lancaster) of Lancaster, Pennsylvania will perform laboratory analytical analysis services for overburden groundwater delineation, baseline conditions including soils and natural attenuation parameters analysis, and groundwater analysis if needed during the performance monitoring well network installation activities. Lancaster is a National Accredited Laboratory Accreditation Program (NELAP) and PADEP certified laboratory (Certification No. 36-00037). Lancaster point of contact will be Ms. Barbara Weyandt; and
  - SiREM Laboratories, Inc. / University of Toronto Stable Isotopes Laboratory (UT-SIL) of Toronto, Ontario, Canada is a contract laboratory of SiREM. UT-SIL will perform CSIA analysis UT-SIL points of contact will be Ms. Sandra Dworatzek of SiREM and Dr. Barbara Sherwood-Lollar of UT-SIL.
- **Drilling Subcontractor:** Advanced Drilling, Inc. (Advanced) of Pittstown, New Jersey will perform drilling related services. Advanced is a licensed driller within the Commonwealth of Pennsylvania (Registration No. 2178). Advanced point of contact will be Ms. Vicky Alberalla and Mr. Brian Wagner;
- **Land Surveyor:** Dennis W. Sklar, Inc. (DWS) of Philadelphia, PA will complete surveying services. DWS is a licensed Land Surveyor within the Commonwealth of Pennsylvania (License No. SU075154). The land surveyor will be required during the RD field activities to survey in the investigation locations during the overburden groundwater delineation, existing monitoring wells within OU2, and the newly installed performance monitoring wells; and
- **Utility Clearance Subcontractor:** The utility clearance subcontractor is EnviroPhysics, Inc. of Lawrenceville, NJ. The utility clearance contractor will be used for subsurface utility clearance prior to completion of intrusive field investigation activities as part of the OU2 overburden groundwater delineation and performance monitoring well network installation RD field activities.

5.2 Field Sampling Schedule

The RD Implementation Timeline is presented within Figure 9. Per the RDWP, the PDI field activities will begin immediately upon approval of this PDI Work Plan. Per the RDWP, the PDI activities (i.e., groundwater delineation and EISB treatability study) will be completed in approximately 165 days. The overburden groundwater delineation field activities will be completed in approximately 65 days assuming no delays or requirements for additional delineation sampling. The tentative schedule for the PDI field activities is as follows:

- Week of 3 June 2013:
  - Siting of temporary wells TW01 to TW12, direct push sampling locations TW13 to TW40, and locating existing monitoring well locations within the OU2 overburden groundwater aquifer area (see Section 5.4.15 for listing).
  - Utility clearance of temporary wells TW01 to TW12, and direct push sampling locations TW13 to TW40.
- Beginning week of 10 June 2013 and ending week of 24 June 2013:
  - Completion of temporary wells TW01 to TW12, including collection of soil samples from TW01/SB01 to TW10/SB10.
  - Completion of direct push sampling locations TW13 to TW40, including collection of groundwater samples. Abandonment of direct push sampling location to be completed following collection of groundwater sample at each location.
  - Completion of synoptic round of groundwater elevations from temporary monitoring wells TW01 to TW12, and existing monitoring wells RI23, RI24, RI25, RI28, RI29, RI30, and RI31.
  - Collection of groundwater samples from temporary monitoring wells TW01 to TW12, and existing monitoring wells RI23, RI24, RI25, RI28, RI29, RI30, and RI31.
  - Completion of survey of temporary monitoring wells TW01 to TW12, direct push sampling locations TW13 to TW40 and existing monitoring wells within the OU2 overburden groundwater aquifer area (see Section 5.4.15 for listing).
  - Abandonment of temporary monitoring wells TW01 to TW12.

The above schedule is subject to weather, contractor availability and other factors that could cause delay that are outside the control for completion of the PDI field activities.

As noted in the RDWP, overburden groundwater delineation field activities may require additional time. If initial laboratory analytical results indicate further delineation is required, an extension of the submittal of the Intermediate (60%) Design Submittal will be requested to USEPA to allow for the inclusion of the additional overburden groundwater delineation sampling results. If extension of submittal of the Intermediate (60%) Design submittal is not granted by

USEPA, then partial overburden groundwater delineation results will be provided in the Intermediate (60%) Design submittal with the remaining results submitted within the Pre-Final (90%) Design submittal.

As outlined within the RDWP, the overburden groundwater delineation field activities and preliminary/interim results of the EISB treatability study will be presented within Preliminary PDI Report within the Intermediate (60%) Design submittal and the final EISB treatability study results will be presented within the Final PDI Report within the Pre-Final (90%) Design submittal.

5.3 Field Activities

After procurement of materials, subcontracting and securing of access agreements for the facilities within the overburden area of OU2, the planned PDI field activities include the following:

- Site reconnaissance and investigation siting;
- Subsurface utility clearance;
- Clearing/grubbing (if necessary);
- Overburden groundwater delineation field activities which includes:
    - Temporary monitoring well soil profiling and soil sampling,
    - Temporary monitoring well installation
    - Direct push groundwater sampling,
    - Temporary and existing monitoring well groundwater monitoring and sampling, and
    - Direct push and temporary monitoring well abandonment.
- EISB treatability study soil and groundwater collection;
- Assessment and disposal of PDI IDW; and
- Survey of overburden groundwater sampling locations and existing monitoring wells within the OU2 overburden groundwater investigation area.

5.4 Field Operations and Sampling Procedures

Each sample, field measurement, and field activity will be properly documented to facilitate timely, correct, and complete analysis of actions concerning the PDI. The following Geosyntec standard operating procedures (SOP) are referenced herein and are included within Appendix C as follows:

- SOP100: Water Level Measurement Procedures
- SOP110: Groundwater Sampling Using the Low-Flow Protocol
- SOP200: Surface Soil Sampling

- SOP210: Soil Description Visual
- SOP240: Direct Push Soil Sampling
- SOP410: Packaging and Shipping of Environmental Samples

5.4.1 Field Preparation

As preparation for PDI field activities, the following preparations will be undertaken:

- The RD Project Manager or Field Manager will ensure that subcontractors (i.e., drilling, surveying, laboratories, etc.) have been contracted and scheduled;
- The RD Project Manager or Field Manager will ensure all necessary supplies (i.e., sampling tools, instruments, sample containers, etc.) have been ordered and are ready for use;
- Stabilus has obtained access from:
  - Constantia to the former Stabilus facility property;
  - Sensor to the former BAE facility property;
  - Montgomeryville Township to Whistle Stop Park; and
- Coordination regarding sample collection, delivery, analysis, and requested deliverables will be undertaken with the various laboratory contacts.

5.4.2 Field Documentation Procedures

Field sampling operations and procedures, observations, and other pertinent information will be documented by field personnel in bound field logbooks and the appropriate field forms (see SOPs in Appendix C). When appropriate, field operations and procedures will be photographed. Documentation of sampling operations and procedures will include but not limited to documenting the following:

- Time and date on and off the Site of field personnel;
- Start/stop time of Site activities;
- Weather conditions;
- Daily objective;
- Calibration of field instruments;
- Field sampling equipment used including serial numbers;
- Lithological descriptions;
- Static water level measurements;
- Pumping rates and water quality parameters; and
- Sample location identification and list of analyses.

Field logbooks will be waterproof and bound. The logbooks will be dedicated to the Site. No pages will be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or at the end of each day of activities.

5.4.3 Site Reconnaissance and Investigation Siting

Site reconnaissance will be completed in order to locate the proposed overburden groundwater sampling locations shown on Figure 7. A handheld Global Positioning System (GPS) unit will be used to mark proposed locations in the field (Note GPS unit is a Trimble Geoexplorer 6000 Series, accuracy 10 cm, frequency 1 Hz).

As part of this Site reconnaissance, the GPS unit will be used to aid in locating the existing monitoring wells within the OU2 overburden groundwater investigation area (see Figure 7). The monitoring wells will be assessed to determine if clearing and grubbing will be required to access them. Each monitoring well will be inspected for integrity and will be sounded with an electronic water level meter to measure the depth to groundwater. A weighted measuring tape will be used to measure total monitoring well depth. Of the existing well network, 7 overburden groundwater monitoring wells are within the OU2 overburden groundwater area which is the focus of the PDI field activities. These 7 wells are shown on Figure 7 as RI23, RI24, RI25, RI28, RI29, RI30, and RI31, and will be included within the groundwater sampling program as summarized in Section 5.4.9.

5.4.4 Subsurface Utility Clearance

The drilling contractor will be responsible for contracting Pennsylvania “One-Call” System prior to performing any subsurface drilling or excavation work by calling “811”. The utility company mark-outs provided by the “One-Call” service are required to address underground public utility lines (e.g., gas, water electric, communications, etc.) regardless of whether or not they are on private property. The notification to “One-Call” must be made by the drilling or excavation contractor. The notification may not be made by other parties (e.g., consultant, property owners, government agency, etc.).

Supplemental utility clearance will be performed in the vicinity of each drilling location in addition to the “One-Call” notifications. The supplemental clearance is required given the “One-Call” system does not enter onto private property, nor does it locate on Site (non-public) utilities. A subsurface utility locating subcontractor will screen each sampling location using various geophysical techniques (i.e., ground penetrating radar, GPR; electromagnetic survey, EM; etc.). Locations will also be clear of any over-head power lines or other obstructions.

5.4.5 Overburden Groundwater Delineation Field Activities

Figure 7 presents the proposed overburden groundwater delineation sampling locations. The rationale for the sampling locations and analysis were summarized in Section 3. A total of 40 sampling locations will be completed. As noted in Section 3, 12 sampling locations along the low in the bedrock topography will be completed as temporary monitoring wells shown as TW01 to TW12 on Figure 7. At 10 of these locations (TW01 to TW10) will include both soil and groundwater sampling for VOC laboratory analysis shown as SB01 to SB10 on Figure 7. Groundwater samples from temporary monitoring well locations TW01 to TW10 will also be analyzed for CSIA, and monitored natural attenuation parameters (which include anions, alkalinity, ferrous iron, dissolved hydrocarbon gases) to provide baseline data for the EISB remedy. The remaining 28 sampling locations, shown as TW13 to TW40 on Figure 7, will be collected as direct push groundwater samples (i.e., grab groundwater samples) using a temporary 1-inch sampling point.

5.4.6 Temporary Monitoring Well Soil Profiling and Sampling

For the 12 temporary monitoring well installations the direct push technology will be used (Geoprobe® or similar rig) to conduct the subsurface investigation (i.e. soil boring and temporary monitoring well installation). Sampling will be in accordance with Geosyntec's *SOP240: Direct Push Soil Sampling* and *SOP200: Surface Soil Sampling* in Appendix C. Continuous 2-inch soil cores will be collected at 4-foot intervals in acetate liners until refusal at the top of bedrock. Field personnel shall note the soil type, color, odor, amount of recovery, screen the soil core for VOCs by using a PID, and the depth of refusal. Soil descriptions will be documented according to Geosyntec's *SOP210: Soil Description Visual-Manual Procedure of the Unified Classification System* in Appendix C. Information shall be documented in the field logbook and on lithologic boring logs. Sampling equipment will be decontaminated between each temporary well location (see Section 5.4.14).

Soil samples will be collected from TW01/SB01 to TW10/SB10 shown on Figure 7 from the six-inch interval above the weathered bedrock zone, or from the six-inch interval with elevated PID readings and/or where visual staining is observed. VOC sample collection will be directly from the acetate liner, within an undisturbed interval of the core, using a 5-gram Terra-core sampler. Further details of the sampling procedure are summarized in Geosyntec's *SOP200: Surface Soil Sampling* and *SOP240: Direct Push Soil Sampling* in Appendix C.

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix D, with a summary of the QA/QC samples to be collected provided within Section 5.4.12.

5.4.7 Temporary Monitoring Well Installation

Upon reaching top of bedrock at locations TW01 through TW12, a temporary monitoring well will be installed. Upon completion of drilling, the boring will be sounded with a weighted measuring tape to verify the total depth of the boring, and gauged with a depth to water meter to confirm presence of water. If the location is dry, one other attempt would be made at a location approximately 10 feet away either towards the trough or along strike, with the final location determined in the field in agreement with USEPA's representative.

If the location has water, the well casing and well screen will then be assembled ex-situ and lowered into the boring. If the boring is too deep to assemble ex-situ and lowered into the boring, it may be assembled in manageable lengths and each length attached as the well casing and screen are lowered into the boring. All well casings and screens will be joined through threaded connections equipped with seals, as solvent welds are not suitable due to the potential for contamination from the solvent glue. The well construction will be as follows:

- 1-inch diameter 5-foot pre-packed threaded Schedule 40 PVC well screen at base of borehole (i.e., just above bedrock);
- Pre-packed well screen will have equivalent of 10-slot well screen, and No. 1 well sand or equivalent;
- 1-inch diameter threaded Schedule 40 PVC riser to ground surface;
- 6-inches to 1-foot of No. 00 well sand (i.e., sugar sand) will be placed above the pre-packed well screen; and
- 6-inches to 1-foot of bentonite chips will be placed and then hydrated to provide a seal.

Temporary monitoring wells TW01 to TW12 will be constructed as temporary wells, with grouting above the pre-packed well screen (i.e., grout plug), and will not have a surface completion. Well casing materials will be measured to the nearest 0.1 foot and steam cleaned before being used for well construction (materials in protective packaging do not require steam cleaning unless exposed to dirty or contaminated surfaces prior to installation). The bottom of the well will be fitted with a secure bottom end cap. No PVC cement or other solvents will be used to fasten the well casing joints, well screen joints, or end caps. The wells will be secured with lockable well caps for the period of stabilization prior to sampling. Drilling equipment will be decontaminated between each drilling location (see Section 5.4.14). The following well construction data shall be recorded within the field logbook following well construction:

- well designation;
- date of well installation;
- driller and driller company;
- depth of borehole prior to well installation;

- well construction material (i.e., Schedule 40 PVC) of screen and riser;
- well diameter (i.e., 1-inch) of screen and riser;
- length and slot size of well screen;
- length of riser;
- length of additional sand (i.e., sugar sand) above pre-packed well screen;
- length of well seal/plug (i.e., cement/bentonite or bentonite chips) above additional sand, and hydration method;
- static water level with borehole before and static water level in well after installation;
- height of well casing above/below ground surface;
- total depth of well after installation; and
- confirmation of placement of lockable well cap, and locked (note lock type and number).

Following 24-hours after construction, temporary wells TW01 through TW12 will be developed through purging of three well volumes or until the purge water is visually clear, whichever occurs first. Development water will be containerized in 55-gallon drums for later disposal as Investigation Derived Waste (IDW) (see Section 5.4.16). The following data shall be recorded within the field logbook during development:

- well designation;
- date of well installation;
- date of development;
- static water level before and after development;
- quantity of standing water in well and annulus (30-percent porosity of saturated annulus assumed for calculation) prior to development;
- depth from top of well casing to bottom of well;
- screen length;
- depth from top of well casing to top of sediment inside well, before and after development;
- physical character of removed water, including changes during development in clarity, color, particulates, and odor;
- type and size/capacity of pump and/or bailer used;
- height of well casing above/below ground surface;
- typical pumping rate; and
- quantity of water removed and time for removal.

A well construction diagram for each well will be completed by the field scientist and submitted to the reviewing geologist or engineer upon completion of each well. Well installation and construction data, and well development data will be summarized in the field logbook.

5.4.8 Direct Push Groundwater Sampling

Direct push technology will be used (Geoprobe® or similar rig) to complete the grab groundwater sampling from sampling locations TW-13 to TW-40 at locations shown on Figure 7. A temporary 1-inch sampling point will be used to collect grab groundwater samples. Direct push drill rods will be advanced until refusal. Upon reaching refusal, a discrete groundwater sample will be collected via peristaltic pump through a temporary sampling point (i.e., 1-inch diameter Schedule 40 PVC 5-foot 10-slot well screen and riser to ground surface within the open borehole). Groundwater samples are anticipated to be collected within 2-hours of completion of the direct push sampling point. Sampling information shall be documented in the field logbook. Drilling and sampling equipment will be decontaminated between sampling locations (see Section 5.4.14).

Direct-push groundwater sampling via temporary 1-inch sampling point will be completed at sampling locations TW13 to TW40 shown on Figure 7. The grab groundwater sample will be collected from the interval just above refusal, which is assumed to be just above the top of bedrock at the interface of the overburden and bedrock aquifers. If the location is dry, one other attempt will be made at a location approximately 10 feet away either towards the trough or along strike, with the final location determined in the field in agreement with USEPA's representative.

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix D, with a summary of the QA/QC samples to be collected provided within Section 5.4.12.

5.4.9 Temporary and Existing Monitoring Well Groundwater Monitoring and Sampling

The temporary monitoring well locations TW01 through TW12 will be allowed to equilibrate with the overburden groundwater aquifer for at least a 1-week period prior to monitoring and sampling. A complete synoptic round of groundwater elevations measurements will be collected following completion of all temporary monitoring well installations and prior to their abandonment. Groundwater elevations will be collected from temporary monitoring well locations TW01 through TW12, as well as from existing monitoring well locations RI23, RI24, RI25, RI28, RI29, RI30, RI31 shown on Figure 7. Water levels will be collected per Geosyntec's *SOP100: Water Level Measurement Procedures* in Appendix C. Groundwater samples from the 12 temporary and 7 existing monitoring wells will be collected in accordance with Geosyntec's *SOP110: Groundwater Sampling Using the Low-Flow Protocol* in Appendix C. Groundwater sampling will require the use of the following equipment:

- Bladder pump capable of a flow rate between 100 and 500 milliliters per minute (mL/min);
- Power source and/or compressor;
- Water quality meter with flow through cell (i.e. YSI or similar) for measuring pH, temperature, specific conductance, DO, turbidity, and ORP;
- Calibration solutions for the water quality meter;
- Hach color metric test kit for ferrous iron;
- Electronic water level meter;
- Graduated cylinder and stopwatch to measure flow rate;
- Field logbook;
- PPE;
- 5-gallon bucket and/or 55 gallon drum to containerize purge water; and
- Decontamination supplies.

Prior to well purging, the water quality parameter meter will be calibrated in accordance with the manufacturer's specifications. Calibration information will be recorded in the field logbook and/or field forms as appropriate. The bladder pump will then be carefully lowered to the approximate middle of the well screened section, tubing will be connected to the flow through cell, and a discharge line will run from the flow through cell to the bucket or drum. Pumping will begin at a steady rate between 100 to 200 mL/min, and depth to water measurements will be collected frequently to ensure less than 0.1 feet of drawdown occurs. Water quality parameter readings and depth to groundwater measurements will be collected every 5 minutes while purging. Purging will continue until water quality parameters stabilize (three consecutive readings), which is defined as follows:

- ±0.1 units for pH;
- ±3% for specific conductance;
- ±10 mV for ORP;
- ±10% for temperature;
- ±10% for turbidity for values greater than 10 NTUs; and
- ±10% for DO.

Samples will be collected after water quality parameters have stabilized and measurements recorded. For the samples collected from temporary monitoring wells TW01 to TW12, turbidity may not stabilize as quickly as the other parameters. If all other parameters have stabilized, then turbidity may be disregarded. For the existing wells, turbidity will be used as a stabilization parameter.

The pump rate and sample intake location will not be adjusted between purging and sampling. Samples will be obtained from the influent line prior to the flow through cell.

Sample containers will be filled in the following order: VOCs, CSIA, dissolved hydrocarbon gases (DHG; e.g., ethene, ethane or methane), general chemistry parameters (e.g., alkalinity and anions), and field measure of ferrous iron (via Hach test kit Model IR-18C, detection of 0 to 10 mg/L).

Table 1 summarizes analytical parameters including matrices, analysis, analytical methods, containers and preservatives, detection limits, and maximum holding times for samples proposed for collection during the PDI field activities. Further details regarding analytical parameters are provided within the QAPP included within Appendix D, with a summary of the QA/QC samples provided within Section 5.4.12.

5.4.10 Direct Push and Temporary Monitoring Well Abandonment

Upon completion of the overburden soil and groundwater investigation and survey, all temporary monitoring well points will be abandoned.

The temporary monitoring wells TW01 through TW12 will be abandoned after collection of a synoptic round of groundwater level measurements, groundwater samples have been collected, and these points have been surveyed. The direct push sampling locations TW13 to TW40 will be abandoned immediately following collection of groundwater samples; however, their location will be field marked with a stake, field paint, and a steel bolt or similar steel bar. The steel bolt or similar steel bar will be placed within the abandoned location just beneath ground surface to aid in field locating at a future date. Direct push and temporary monitoring well locations will be surveyed by a PA-licensed land surveyor as noted in Section 5.4.15.

The temporary groundwater monitoring wells TW01 to TW12 will be abandoned as follows:

- PVC riser and screen will be pulled from the borehole;
- The open borehole will be grouted with a cement and bentonite grout to surface;
- If PVC riser and screen cannot be pulled, then well internal and external annulus will be grouted with a cement and bentonite grout to surface.
- Steel bolt or similar steel bar will be placed within abandoned boring just below surface to aid in field locating in the future.

The direct push groundwater sampling points TW13 to TW40 will be abandoned as follows:

- The temporary sampling point (i.e., PVC riser and screen) will be removed;
- The open borehole will be grouted with a cement and bentonite grout to surface;
- Steel bolt or similar steel bar will be placed within abandoned boring just below surface to aid in field locating in the future.

5.4.11 Collection of Groundwater & Soils for EISB Treatability Study

As part of the PDI field activities, soil and groundwater will be collected for EISB treatability study microcosm construction. Approximately 2 kilograms of soil and 6 liters of groundwater will be collected in the general area of TW01/SB01 as shown on Figure 7. Soil and groundwater samples will be shipped to SiREM following standard international shipping procedures.

5.4.12 Soil and Groundwater Sampling Quality Assurance and Quality Control

Per Section 7, the appropriate quality assurance/quality control (QA/QC) samples will be collected for each media sampled. A summary of the field QA/QC samples to be collected during the PDI field activities are summarized on Table 1. QA/QC samples are further described in Section 7 and within the QAPP in Appendix D.

5.4.13 Sample Handling and Transport

Sample handling and transport will be completed in accordance with Geosyntec's *SOP410: Packaging and Shipping of Environmental Samples*. Sample jars, coolers, and packaging material will be supplied by the analytical laboratory. Details on the numbers and type of sample containers are provided in the QAPP. Equipment needed for packaging and shipping sample coolers will include the following:

- Sturdy sample cooler;
- Plastic zip-top bags of various sizes;
- Clear plastic packing tape;
- Ice;
- Custody seals;
- Completed chain-of-custody record; and,
- Completed air bill.

Proper packaging is necessary to ensure the protection of the samples during shipment. The following steps should be followed when packing sample coolers for shipment via air:

- Caps on bottleware are secure; check labels/tags, and chain-of-custody are filled out properly;
- Double bag ice in large plastic zip-top bags and seal;
- All sample containers will be placed in an appropriately-sized plastic zip-top bag. Glass bottles shall be wrapped in bubble wrap before placing in zip-top bag;
- The chain-of-custody record will be placed in a plastic zip-top bag and taped to the inner side of the sample cooler lid;

- Clear packing tape will be wrapped around the ends of the sample cooler twice before attaching the signed custody seals to the top half of the sample cooler. Clear packing tape shall be wrapped over the custody seals; and
- Address labels and/or air bills will be affixed to the outside of the cooler.

5.4.14 Equipment Decontamination

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to and between collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

Non-disposable/non-dedicated sampling equipment (pumps, stainless steel bowls, trowels, etc.) will be decontaminated after sampling at each location is completed and will consist of the following procedures:

- Disassemble pump (if necessary);
- Potable water rinse;
- Alconox solution wash;
- Deionized water rinse;
- Methanol spray (pesticide-grade) rinse;
- Air dry;
- Final deionized water rinse; and
- Air dry.

Once the equipment is dry, it will be re-assembled for reuse at the next location or wrapped in aluminum foil for use during the next day's activities.

Groundwater elevation gauging equipment (i.e., water level meter) decontamination will consist of the following procedures:

- Alconox solution wash;
- Deionized water rinse;
- Air dry.

Oversized equipment (drilling rods, direct push samplers, etc.) will be decontaminated after each drilling location is completed as follows:

- Alconox solution wash;
- Deionized water rinse;
- Air dry.

At the end of each day or beginning of each day, oversized equipment decontamination will be completed within a decontamination pad constructed within the Waste Management Area. IDW liquids and solids from the decontamination pad will be transferred to 55-gallon steel drums for later disposal (see Section 5.4.16). At the end of each day or beginning of each day, the oversized equipment decontamination will consist of the following procedures within the decontamination pad within the Waste Management Area:

- Removal and containment of visible soils;
- Potable water rinse;
- Alconox solution wash; and
- High pressure potable water rinse (i.e., power wash).

Decontamination liquids and solids will be transferred to the appropriate IDW 55-gallon steel drum for later disposal (see Section 5.4.16).

5.4.15 Survey of Overburden Groundwater Sampling Locations and Existing OU2 Overburden and Bedrock Wells

Upon completion of intrusive activities and prior to abandoning the temporary monitoring wells, survey of OU2 intrusive investigation locations and existing monitoring wells in the area of the OU2 overburden groundwater investigation will be completed by DWS, a Pennsylvania-licensed Land Surveyor. The existing monitoring wells within the OU2 overburden groundwater investigation area to be surveyed are shown on Figure 7 and listed as follows:

- Overburden wells: RI-23, RI-24, RI-25, RI-28, RI-29, RI-30, RI-31; and
- Bedrock wells: RI-6S/D, RI-18S/D, RI-19S/D, RI-27S/D, RW-4S/I/D, RW-5S/I/D, RW-6S/I/D, W3, W4, W5, W6, W7, W8, and W9.

The survey will include horizontal and vertical control referenced to the Pennsylvania State Plane Coordinate System NAD 1983 and NAVD 1988, of all new soil borings/temporary monitoring wells and direct push groundwater sampling locations completed during PDI field activities as well as existing overburden and bedrock monitoring wells related to OU2. For existing overburden and bedrock monitoring wells, the reference notch in the top of the riser pipe, the monitoring well monument, and the concrete base (or ground surface if no concrete base is present) will be surveyed to the nearest 0.01 foot relative to mean sea level. For the PDI locations the ground surface at the location of the collected samples and the top of the temporary monitoring well casing will be surveyed. Existing survey monuments or benchmarks within the area of the Site will be tied into the survey to the extent possible and/or available.

5.4.16 Management of Investigation Derived Waste

Waste generated during Site investigation will be managed per the WMP presented in Section 4. Waste streams generated, as part of the PDI field activities will consist of soil, groundwater, and

PPE. Soil waste will be generated from soil borings and monitoring/temporary monitoring well installation. Waste-water will be generated from well installation, well development, sampling, and decontamination. PPE and other disposable equipment, which may be used during investigation activities, include: acetate liners, tubing, plastic sheeting, nitrile gloves, etc.

All wastes generated will be segregated and containerized in 55-gallon steel drums, staged in the equipment staging and waste management area, and labeled as non-hazardous waste as defined in the WMP. Upon completion of investigation activities, wastes will be profiled and scheduled for transport and taken to an appropriate off-site disposal facility.

5.5 Sample Designation

A sample numbering system will be used to identify each sample collected for laboratory analysis during the PDI. The numbering system will ensure that each sample is uniquely identified and will allow for retrieval of sample information about a particular sample location from a database. The field personnel will maintain a listing of sample numbers in the form of a sample log.

The field personnel will record the sampling activities for each day in the field logbook. The following information will be recorded for each sample:

- Unique sample location identification number:
  - TW01_mmddyy for groundwater sampling locations, and
  - SB01(depth-depth)_mmddyy for soil sampling locations;
- Date/time of sample collection;
- Sampler's initials;
- Volume of sample needed for specific analysis; and
- Analysis required and preservative.

6. EISB TREATABILTY STUDY

The objective of the EISB treatability study is to develop EISB design criteria to be used in the RD. The preliminary/interim results of the EISB treatability study will be presented in the Preliminary PDI Report as part of the Intermediate (60%) Design Submittal, with the complete EISB treatability study results presented in the Final PDI Report as part of the Pre-Final (90%) Design Submittal.

6.1 Microcosm Construction

Anaerobic microcosms will be constructed by filling 250 mL (nominal volume) glass bottles with approximately 200 mL of Site groundwater and 60 grams (g) of soil, leaving a nominal headspace for gas production (e.g., carbon dioxide [CO_2] and/or methane [CH_4]). In order to maintain anaerobic conditions, the anaerobic microcosms will be constructed in a disposable anaerobic glove-bag, and will be stored and sampled in an anaerobic chamber.

The groundwater for the sterile control microcosms will be amended with mercuric chloride and sodium azide and the soil will be autoclaved to inhibit microbial activity. Anaerobic intrinsic control microcosms will be used to measure intrinsic biodegradation activity and will not receive electron donor amendments. A slow release EVO will be evaluated as an electron donor with and without the addition of a sodium bicarbonate buffer. Additionally, the sodium bicarbonate buffered EVO will also be evaluated with and without bioaugmentation. The electron donor concentration will be based on either the stoichiometric electron donor demand, or upon laboratory dosages used successfully by SiREM in previous biotreatability studies, or the vendor's recommendations. Sodium bicarbonate will be added at a concentration suitable to maintain the pH around 6.8 to 7.2. One replicate of each anaerobic control and treatment will be amended with resazurin to monitor redox conditions.

Microcosms will not be bioaugmented until development of appropriate reducing conditions including sulfate reduction, ORP (less than -50 mV) and the resazurin color indicator has turned clear (note: Resazurin is an oxidation indicator. In the oxidized state, resazurin turns pink. In the reduced state resazurin is colorless). Typically, reducing conditions are achieved after 3 to 4 weeks of incubation. Based upon evaluation of the ongoing results, the designated electron donor treatment microcosms will be amended with a dehalorespiring microbial consortium (KB-1® Plus) to assess the ability of these bacteria to promote or accelerate complete reductive dechlorination of TCE to ethene. KB-1® Plus is a natural microbial consortium containing Dehaloccoides and Dehalobacter bacteria that dechlorinate chlorinated ethenes to ethane and 1,1,1-trichloroethane (1,1,1-TCA) to chloroethene.

All treatments will be constructed in triplicate as detailed in Table 2. All microcosms are constructed similarly and then replicates for each treatment and control set are randomly chosen. Microcosms will be sealed with Mininert™ valves to allow repetitive sampling of each microcosm, and to allow addition of amendments to sustain metabolic/biodegradation activities.

6.2 Microcosm Incubation, Sampling and Analysis

Biotreatability microcosms will be incubated for a period of approximately six months. Aqueous samples will be collected from the control and treatment microcosms every two to three weeks for analysis of VOCs including PCE, TCE, cDCE, VC and DHGs. In addition, at three selected time points, the electron donor amended microcosms will be sampled for analysis of volatile fatty acids (VFAs; e.g., lactate, acetate and propionate) to permit evaluation of electron donor fermentation and longevity. Other analyses will include the measurement of pH and anions (i.e., sulfate, nitrate, chloride and phosphate) by SiREM. VOC and DHG data will be monitored for the dechlorination sequence, anion data will be used to monitor sulfate reduction and track chloride (dechlorination product). VFAs are used as evidence of electron donor fermentation and pH is monitored as reductive dechlorination is an acid producing process.

Baseline Dehalococcoides (Dhc), Dehalobacter (Dhb) and vinyl chloride reductase (vcrA) quantification (Gene-Trac® Dhb and Gene-Trac® VC) will be performed on the groundwater collected from the site to quantify and assess the dechlorination potential of indigenous bacteria. Dhc and vcrA analysis will also be performed at the mid-point (pre-bioaugmentation) and end of the EISB treatability study (post bioaugmentation) on the biostimulated and bioaugmented treatment microcosms. Samples from the individual replicates from the biostimulated and bioaugmented treatment microcosms will be combined to provide sufficient volume (30 mL) for this analysis.

Table 3 provides a summary of the sampling parameters and frequency to be completed during the EISB treatability study. Sampling intervals for individual treatments may be modified (either shorter or longer intervals) during the EISB treatability study based on observed microbial activity, VOC degradation rates, and depletion of electron donors/acceptors.

7. QUALITY ASSURANCE AND QUALITY CONTROL

A summary of the QA/QC procedures, routines, and specifications for activities to be completed during the RD field activities is summarized herein. Details of the QA/QC program are provided in the attached QAPP included as Appendix D. The QAPP was prepared following USEPA *Guidance for Quality Assurance Project Plans* (USEPA, 2002e), and USEPA *Requirements for Quality Assurance Project Plans* (USEPA, 2001). The QAPP addresses sampling procedures, personnel qualifications and data reduction, validation, and reporting. The QA/QC procedures and SOPs for laboratories used during the RD are included in the QAPP including their qualifications within Appendix D.

7.1 Sample Containers and Preservation

The analytical laboratory will supply all bottleware including appropriately preserved sample containers in sealed coolers. The field personnel will be responsible for properly labeling the containers in the field.

7.2 Field Quality Control Samples

Field duplicate samples, field equipment rinsate blanks, and MS/MSD samples will also be collected. Trip blanks will be provided by the analytical laboratory. The field duplicate samples will be labeled with fictitious identification locations and times, and submitted to the laboratory as regular samples. The actual identification of the field duplicate samples will be recorded in the field logbook. A summary of the field QA/QC samples to be collected during sampling are as follows:

- Field duplicate samples will be analyzed for VOC parameters;
- Trip blank samples will be analyzed for VOC parameters and accompany the sample cooler;
- MS/MSD samples will be collected and analyzed for VOC parameters as a check on laboratory quality assurance; and
- Field equipment rinsate blanks will be analyzed for VOC parameters.

7.2.1 Field Duplicate Samples

Field duplicate samples are independent samples collected in such a manner that they are equally representative of the sampling point and parameters of interest at a given point in space and time. Field duplicate samples provide precision information of homogeneity, sample collection, handling, shipping, and storage of samples.

Field duplicates will be collected immediately after the original sample is collected. Field duplicate samples will be analyzed with the original field samples for VOC parameters. One of every twenty (20) samples will be duplicated.

7.2.2 Trip Blanks

Trip blanks are required for VOC samples. They consist of a set of sample bottles filled at the laboratory with laboratory demonstrated analyte free water. Trip blanks accompany sample bottles into the field and are returned to the laboratory along with the collected samples for analysis. Trip blanks must return to the laboratory with the same set of bottles they accompanied to the field.

7.2.3 Field Equipment Rinsate Blanks

The field equipment rinsate blank is designed to address cross-contamination between sample points in the field due to deficient equipment decontamination procedures and through contamination of ambient sources.

One field equipment rinsate blank will be collected and analyzed for VOC parameters each field sampling day.

7.2.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD samples are a form of laboratory QA/QC for determining matrix effects for the laboratory analysis. The matrix effect is a condition in which sample composition interferes with the analysis of the desired analytes. Spiked sample recovery supplies percentage recovery information so that the laboratory can evaluate its measurement accuracy. MS/MSD samples are equal portions of a single initial sample that has been spiked in the laboratory with specific analytes in known quantities and the analytical results must meet certain laboratory requirements to be acceptable.

One MS/MSD sample will be collected and analyzed for VOC parameters for every twenty (20) samples collected as applicable to the method.

7.2.5 Performance Evaluation (PE) Samples

Performance evaluation (PE) samples will be provided by the USEPA, and are used by USEPA to assess the performance of the laboratory, LLI. The PE samples will be provided a single-blinds (i.e., recognizable as a PE sample but of unknown composition) by USEPA. One PE sample will be provided for solids/soils analysis, and one PE sample will be provided for water analysis. The samples will be analyzed for VOC parameters.

7.3 Chain of Custody Procedures

Sample identification and chain-of-custody shall be maintained for the Site through the chain-of-custody procedures as described in the QAPP:

- Sample labels, which prevent misidentification of samples;
- Custody seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory;
- Field logbooks and forms to record information about the Site investigation and sample collection; and
- Chain-of-custody records to establish the documentation necessary to trace sample possession from the time of collection to laboratory analysis.

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TABLES

FIGURES

APPENDIX A

Prior Groundwater and Soil Delineation Isoconcentration Contours

APPENDIX B

Health and Safety Plan (HASP)

APPENDIX C

Geosyntec Standard Operating Procedures (SOPs)

APPENDIX D

Quality Assurance Project Plan (QAPP)